ASIA TURBOMACHINERY & PUMP SYMPOSIUM
SINGAPORE | 22 – 25 FEBRUARY 2016
MARINA BAY SANDS

TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M UNIVERSITY

NATIONAL FERTILIZERS LIMITED, NANGAL UNIT

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REVAMP OF STEAM TURBINE FOR SYNTHESIS GAS COMPRESSOR AT NFL NANGAL

By:
Rakesh Markan
Deputy General Manager(Mech)
NFL Nangal

BOIGRAPHY:

Rakesh Markan

Graduate in Mechanical Engineering

- Nearly 30 Years of Experience in Maintenance, Troubleshooting and Major Overhaul of Steam Turbines and Centrifugal Compressors, Erection and preventive maintenance of connected Steam and Process Gas Piping in Fertilizer Industry.
- Worked in Ammonia Plant- Shell Gasification Process, Ammonia Plant-SMR Process, Urea Plant and Boiler Plants at various positions.
- Worked in Various organizations in Fertilizer Sector, besides the four Units of National Fertilizers Limited, for trouble shooting and subsequent maintenance of high speed rotating machines,.
- Presented papers, on case studies related to reliability maintenance/Improvement in productivity, at various forums in India
- Hands on experience in planning and execution of major turnarounds of Fertilizer Plants.
- At present holds the position as Chief Manager (Mechanical) in Nangal Unit of National Fertilizers Limited.

ABSTRACT:

National Fertilizers Limited, Nangal Unit, India had under taken the revamp of Steam Turbine of Synthesis Gas Compressor in January 2014. The plant startup, after machine revamp, was delayed by 40 days, because of various activities related to machine revamp which were not envisaged before commencement of the revamp. This paper throws light on those unforeseen jobs which lead to delay in startup and the lessons learnt to avoid such delays in future.

SYNTHESIS GAS COMPRESSOR, NFL NANGAL

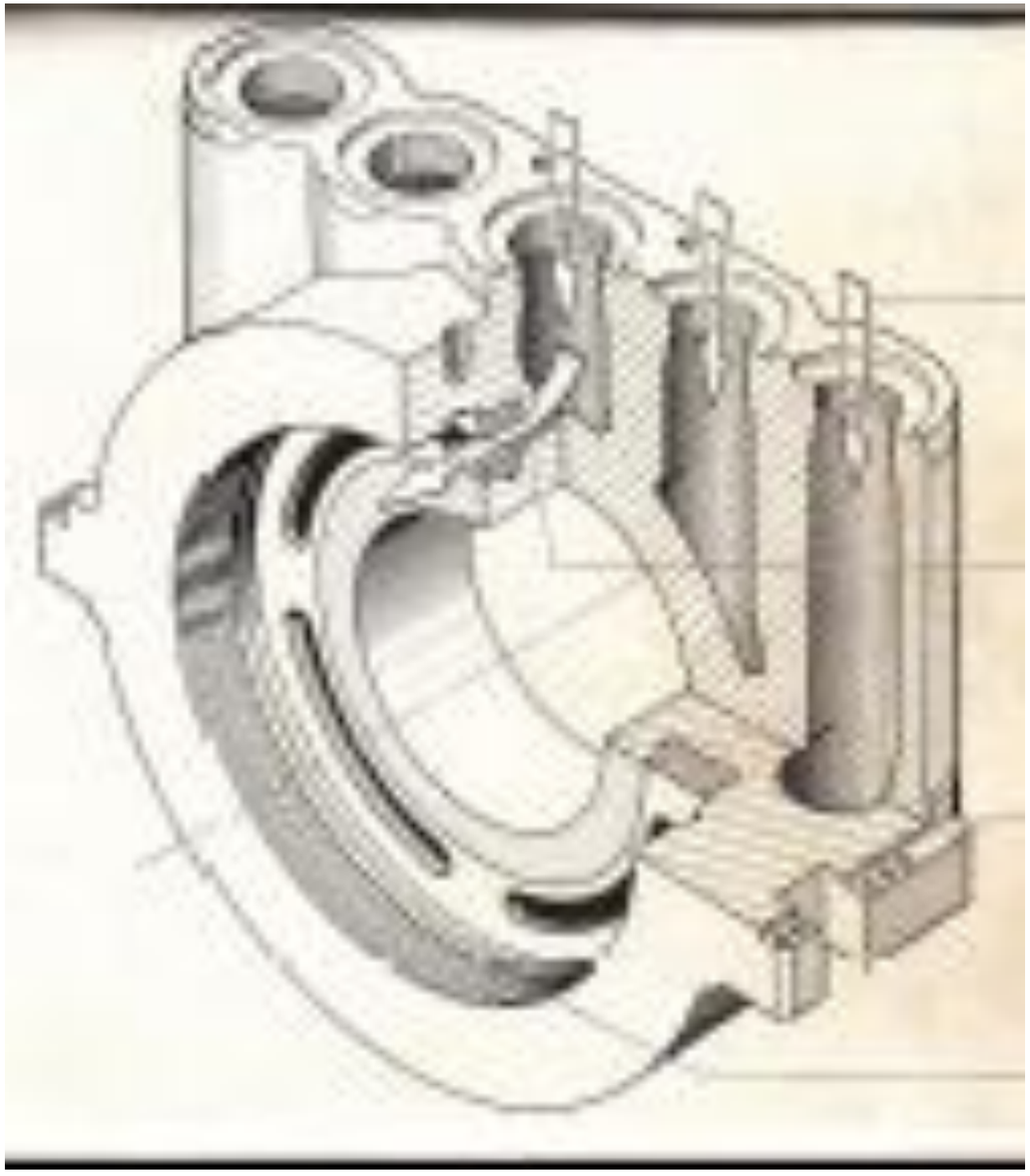
MAJOR JOBS SCHEDULED TO BE CARRIED-OUT DURING REVAMP

- Replacement of Rotor with New High Efficiency one
- Replacement of Nozzle Segment with High Efficiency one
- Replacement of guide blade carrier with New High Efficiency one
- Replacement of Steam Glands
- Replacement of Steam Control Valves with Modified ones

MAJOR JOBS SCHEDULED TO BE CARRIED OUT DURING REVAMP

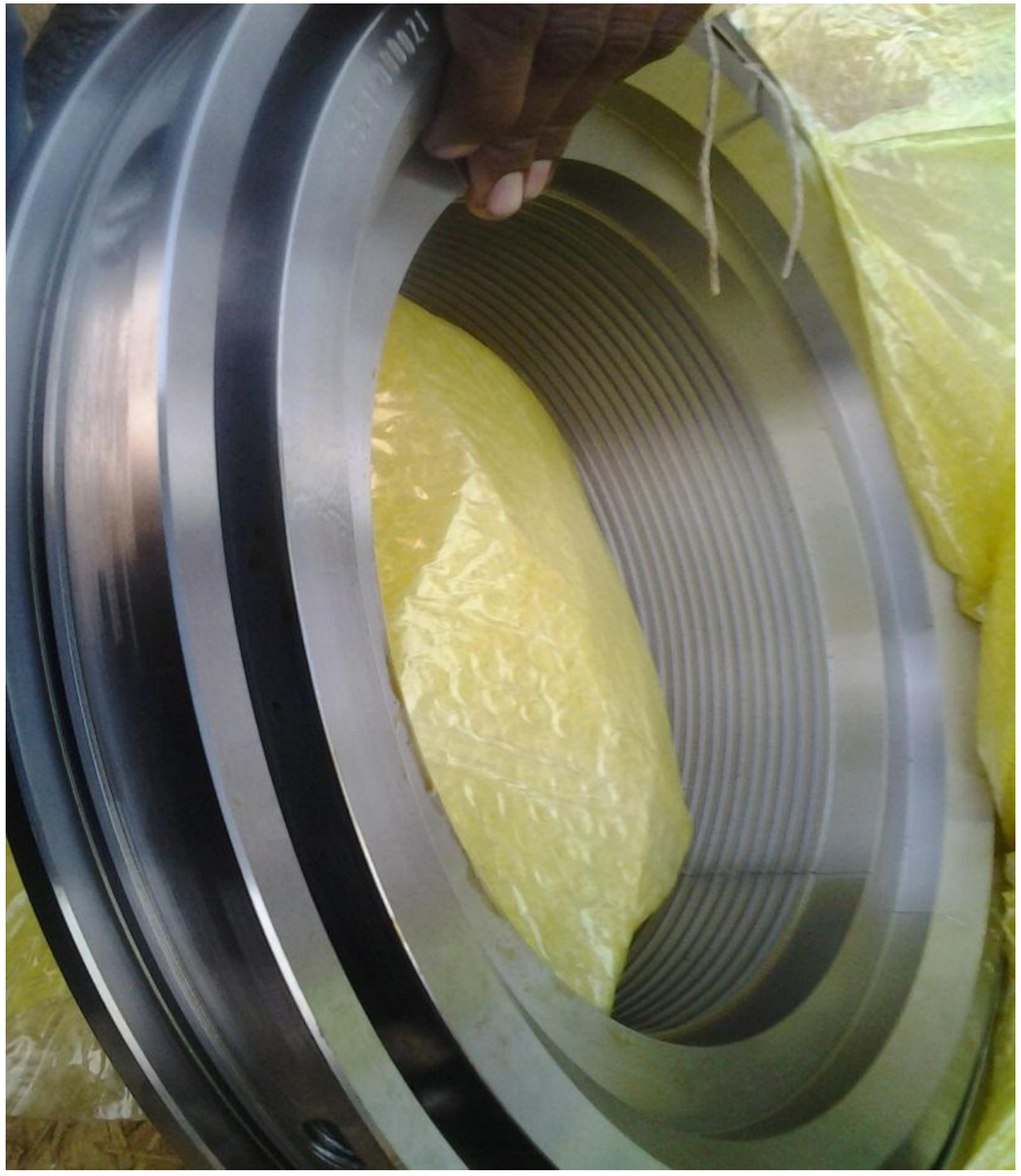
REPLACEMENT OF ROTOR AND GUIDE BLADE CARRIER

REPLACEMENT OF STEAM INLET NOZZLES

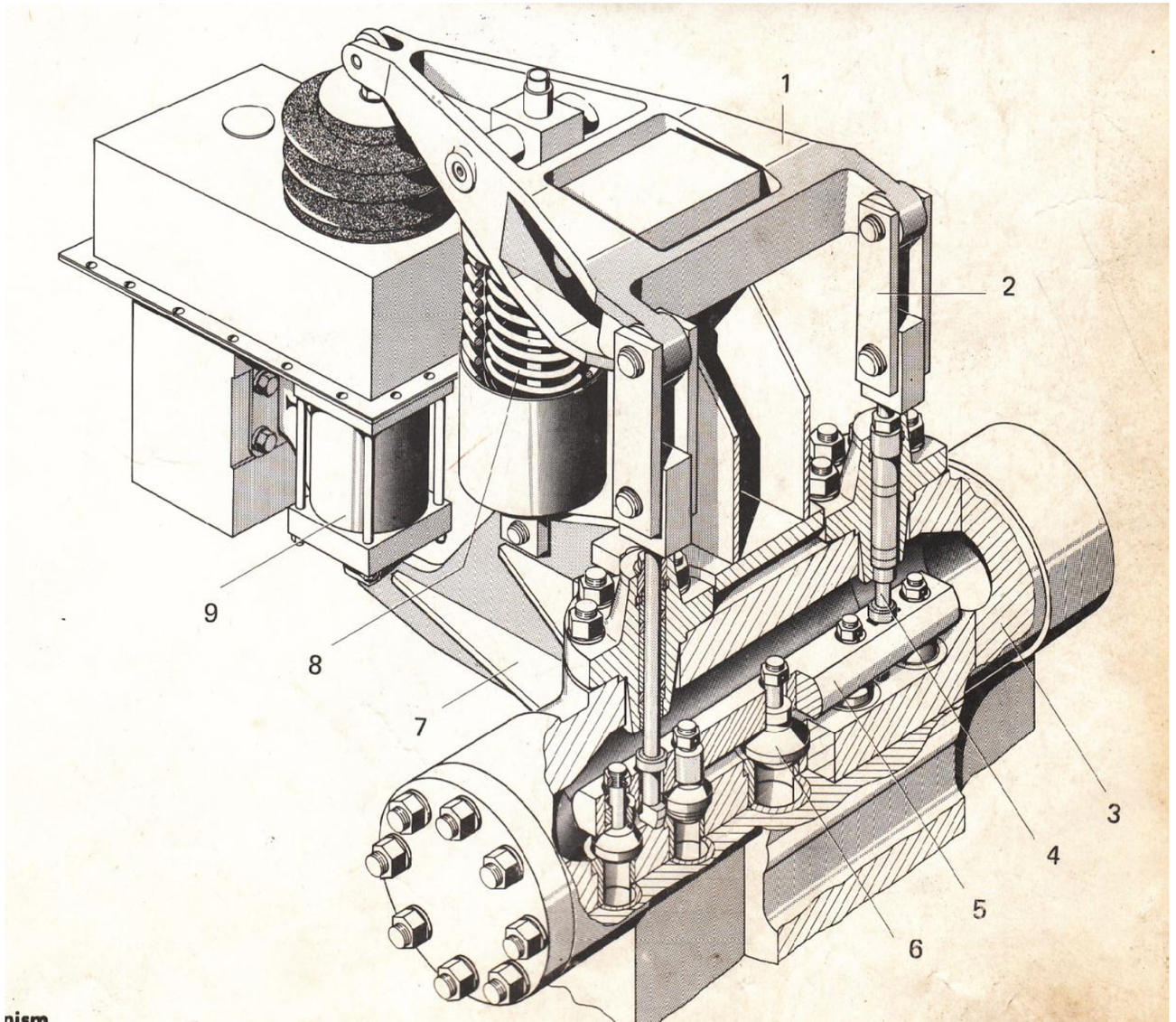


MAJOR JOBS SCHEDULED TO BE CARRIED-OUT DURING REVAMP

REPLACEMENT OF STEAM GLANDS



REPLACEMENT OF STEAM CONTROL VALVES' ASSEMBLY



TIME AS PER ORIGINAL SCHEDULE : 27 DAYS
ACTUAL TIME TAKEN: 67 DAYS

MAJOR ACTIVITIES INVOLVED IN MACHINE OVERHAUL AS PER NORMAL PRACTICE

OPEN TOP CASING
DISMANTLING THE BEARINGS
REMOVE ROTOR,STEAM GLANDS,GUIDE BLADE CARRIERS,NOZZLE BLOCK
CLEANING OF CASING AND PLACE NEW BEARINGS
CENTRING OF NEW NOZZLE BLOCK
CENTRING OF NEW ROTOR WITH TURBINE CASING AND BEARING PEDESTALS
INSTALL NEW NOZZLE BLOCK,CENTRING OF NEW NOZZLE BLOCK WITH ROTOR AND TURBINE CASING

MAJOR ACTIVITIES INVOLVED IN MACHINE OVERHAUL AS PER NORMAL PRACTICE

INSTALL NEW STEAM GLANDS, CENTRING OF GLANDS w.r.t ROTOR AND TURBINE CASING

INSTALL NEW GUIDE BLADE CARRIER, CENTRING OF NEW GUIDE BLADE CARRIER w.r.t TURBINE CASING AND ROTORBOXUP TOP CASING COVER.

ALIGNMENT OF TURBINE WITH DOWNSTREAM MACHINE.

- NUMEROUS HIGH PRECISION MACHINING JOBS CAME UP DURING JOB EXECUTION, WHICH WERE NOT ANTICIPATED BEFORE COMMENCEMENT OF REVAMP.
- ***THESE JOBS WERE NOT COVERED IN THE ORIGINAL SCHEDULE*** BUT THE SAME WERE EXECUTED AND PLAYED A MAJOR ROLE IN EXTENDING THE SCHEDULED TIME

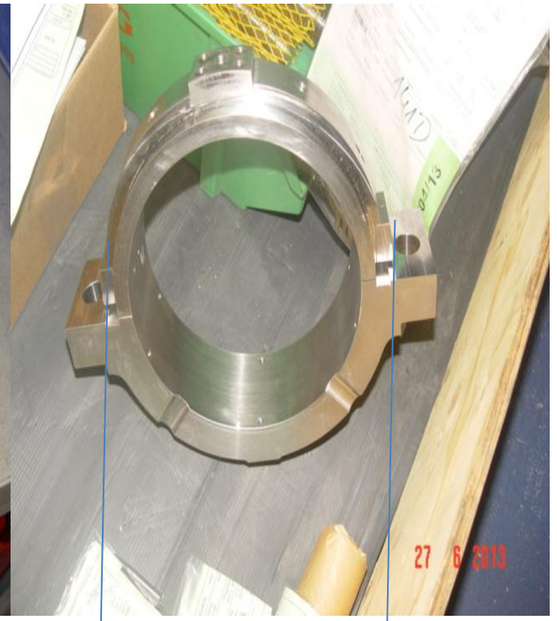
ACTIVITIES WHICH LEAD TO DELAY IN EXECUTION

AS PER AGREEMENT BETWEEN OEMs & CUSTOMER ALL THE NEW REDESIGNED PARTS SHALL BE WITH IMMPROVED EFFICIENCY BUT INTERCHANGEABLE WITH THE ONES ORIGINALLY INSTALLED.

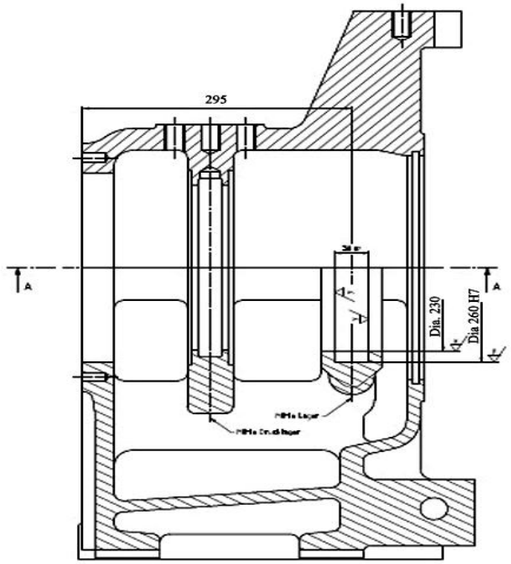
JOURNAL DIAMETER OF THE NEW ROTOR WAS 124.83 MM AGAINST THE ORIGINAL ONE AS 119.82MM.

DESIGN OF BEARINGS WAS CHANGED TO TILTING PAD TYPE INPLACE OF BUSH TYPE.

150mm ϕ

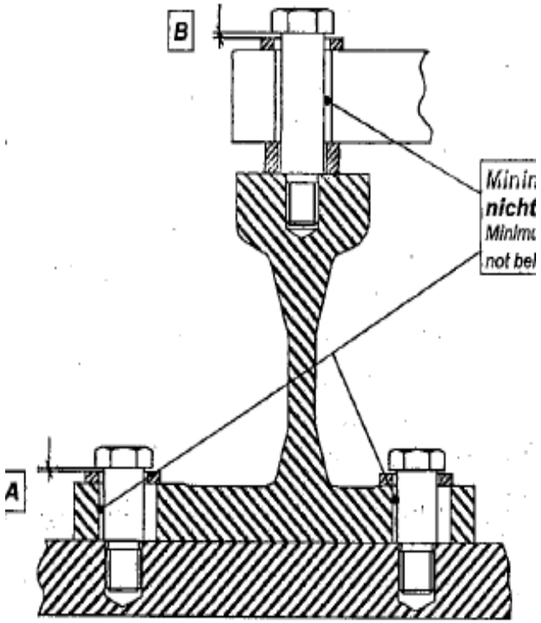


260mm ϕ

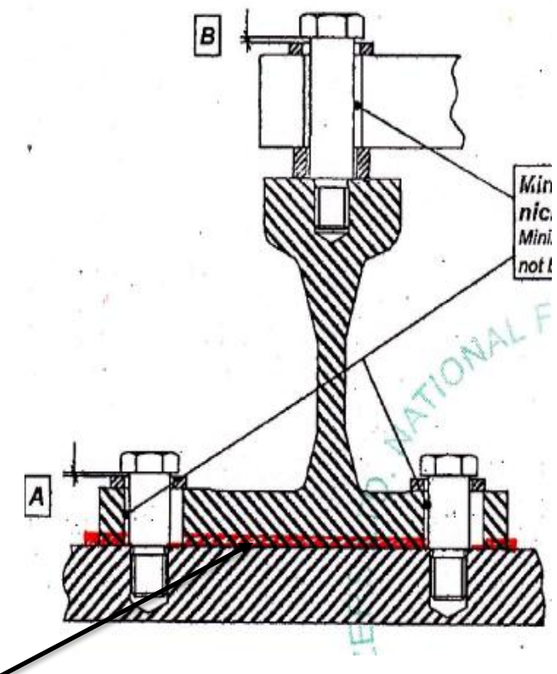


MODIFICATION OF SEATING AREAS OF FRONT END BEARING PEDESTAL

BEFORE MACHINING



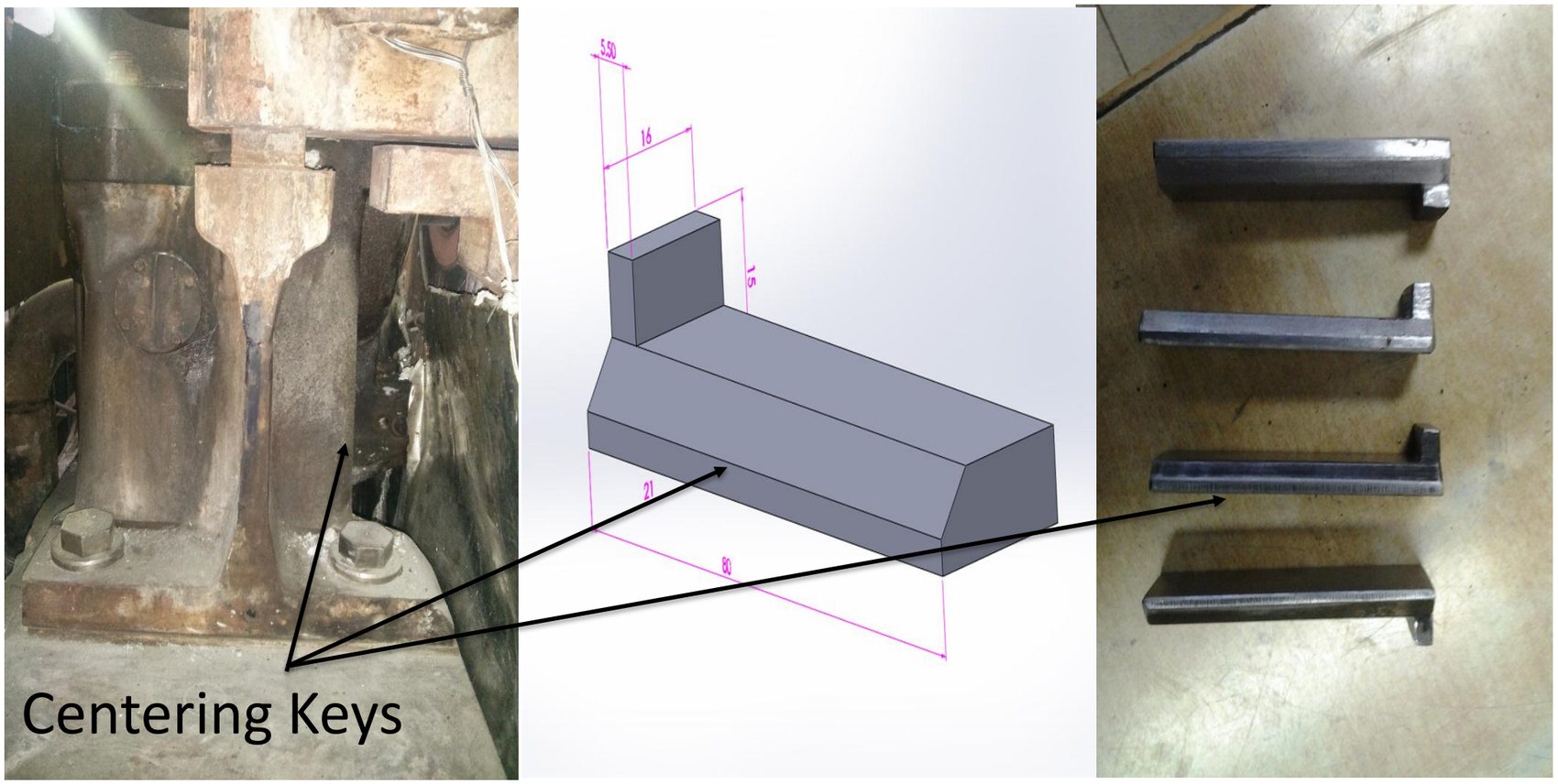
AFTER MACHINING



Packing Plates

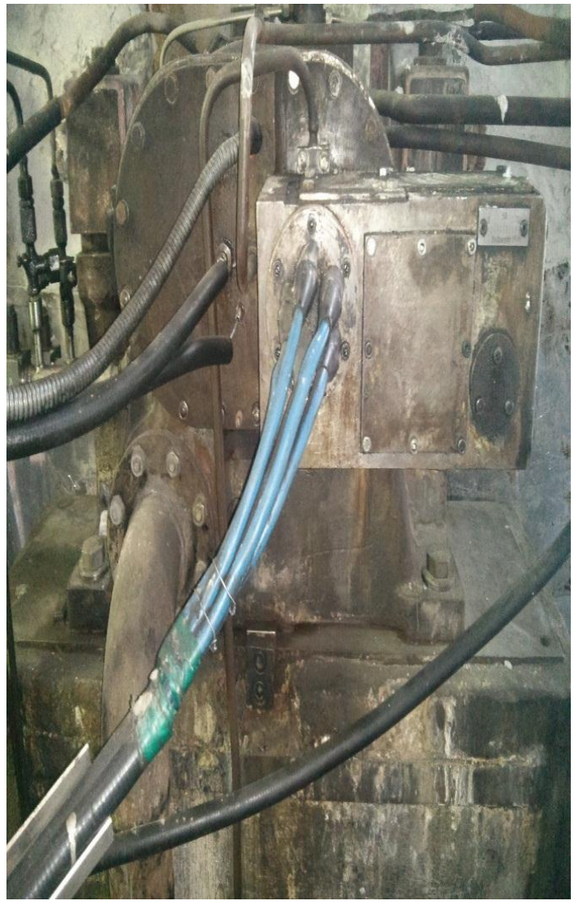
HIGH PRCISION MACHINED COMPONENTS FABRICATED IN LOCAL W/S

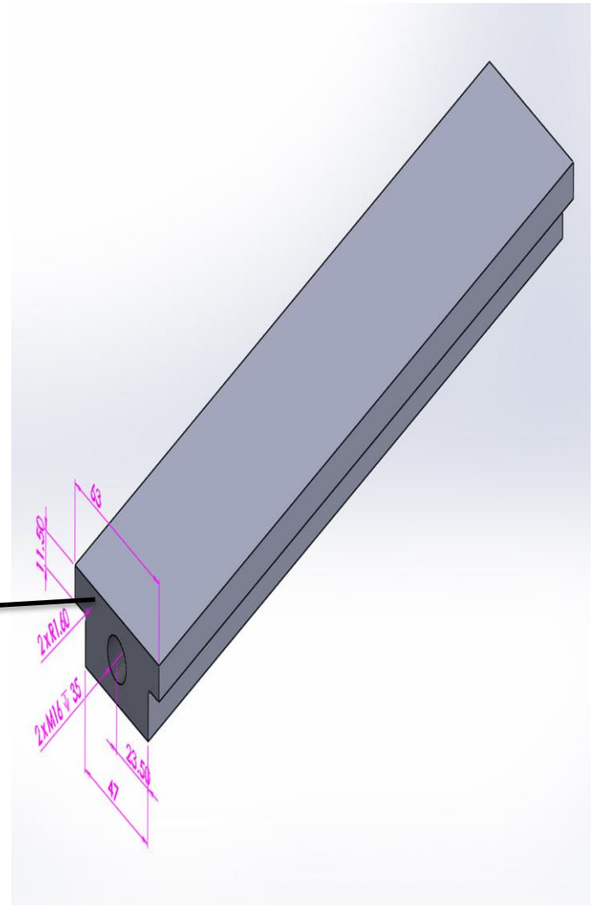
Centering keys for Parallel alignment of Turbine Casing with Bearing Pedestal



HIGH PRCISION MACHINED COMPONENTS FABRICATED IN LOCAL W/S

MAIN AXIAL KEY UNDER FRONT BRG PEDESTAL

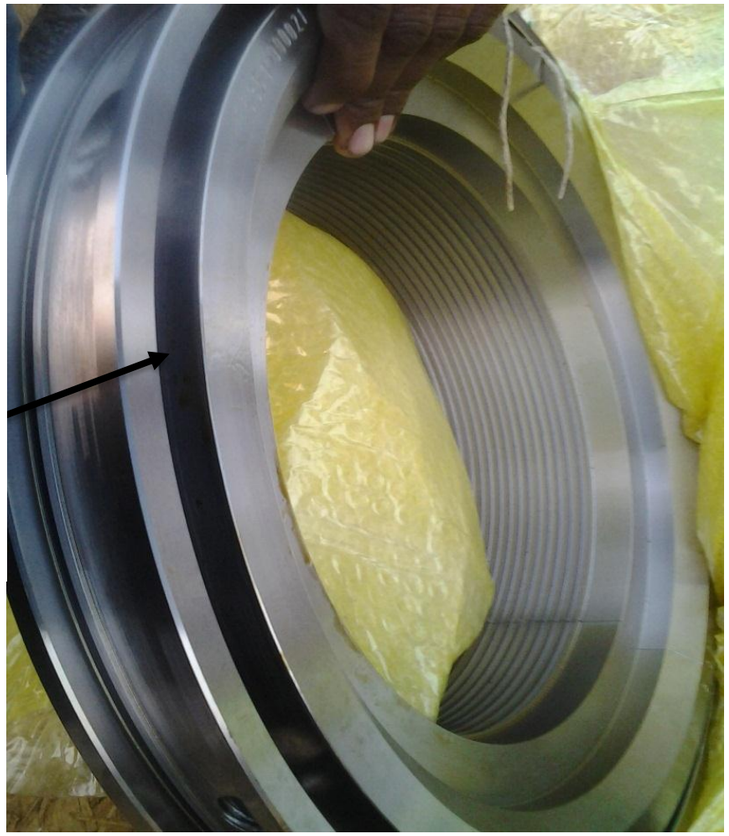




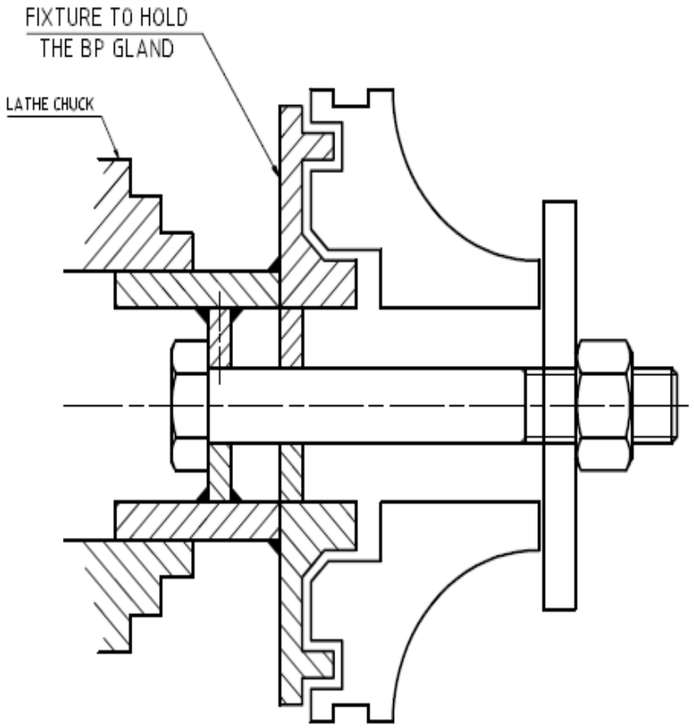
DELAY DUE TO WRONG SEALING ANGLE OF THE OF SEAL RING ON EMERGENCY STOP VALVE 25 DEG. INSTEAD OF 15 DEG.

FIXTURES FOR MACHINING OF STEAM GLANDS WERE MADE TO ACCOMMODATE THE NEW STEAM GLANDS ON LATHE MACHINES IN NFL WORKSHOP

Weld deposit to achieve required diameter



Balance Piston Gland



JOBS SUBSEQUENT TO THE VISIT OF FACT FINDER DEPUTED BY THE OEMs

JOBS SUBSEQUENT TO THE VISIT OF FACT FINDER DEPUTED BY THE OEMs

REMOVAL OF DAMAGED STUDS IN TOP CASING

REPLACEMENT OF STRAINERS IN THE MAIN STEAM INLET LINES. THE JOB REMAINED HELD UP DUE TO NON AVAILABILITY OF SPARE STRAINERS

REPLACEMENT OF ALL OLD DAMAGED STUDS INSTALLED IN THE BOTTOM CASING

BROKEN BOLTS/STUDS IN THE BOTTOM CASING

BOTTOM CASING AFTER REMOVAL OF NOZZLE BLOCK AND GUIDE BLADE CARRIER

NOZZLE BLOCK

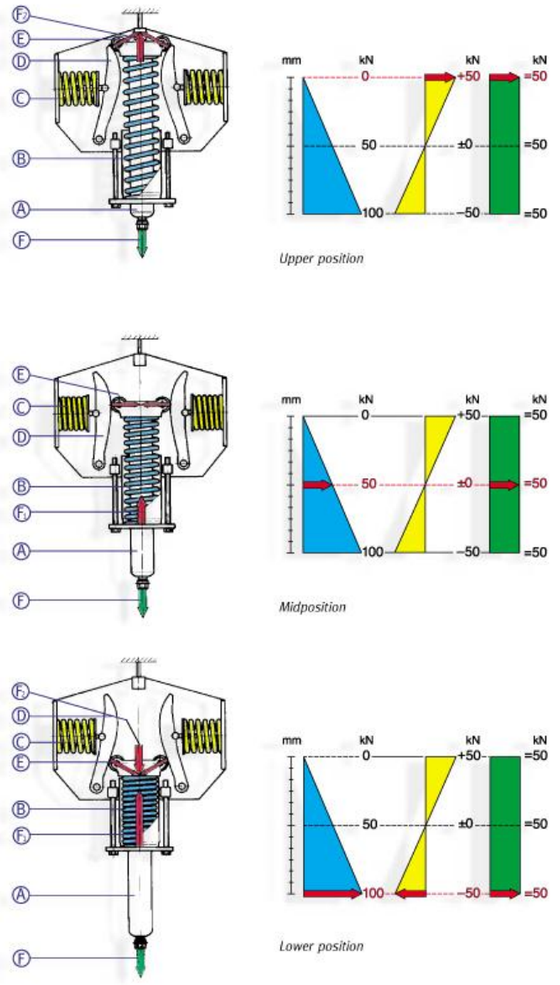
SHIFTING OF BOTTOM CASING TO MECHANICAL WORKSHOP FOR REMOVAL OF CENTER GUIDE KEYS & ECCENTRIC BUSHES

BASIC REFERENCES OF BOTTOM CASING W.R.T FOUNDATION AND BEARING PEDESTALS LOST

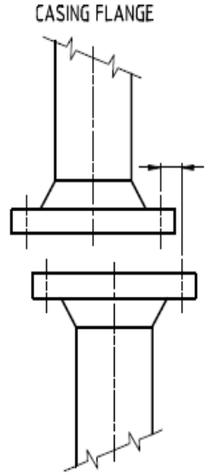
REMOVAL OF CENTRE GUIDE KEYS IN MECHANICAL WORKSHOP

REMOVAL OF ECCENTRIC BUSH FOR NOZZLE BLOCK IN MECHANICAL WORKSHOP

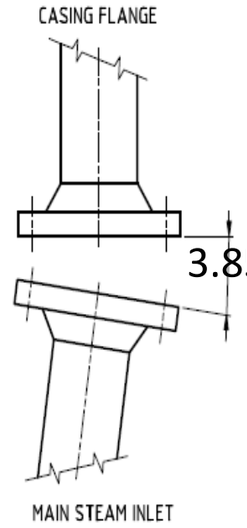
SPRING SUPPORTS WERE FOUND BADLY RUSTED AND FEW WERE FOUND DAMAGED



MISALIGNMENT OF STEAM INLET FLANGES



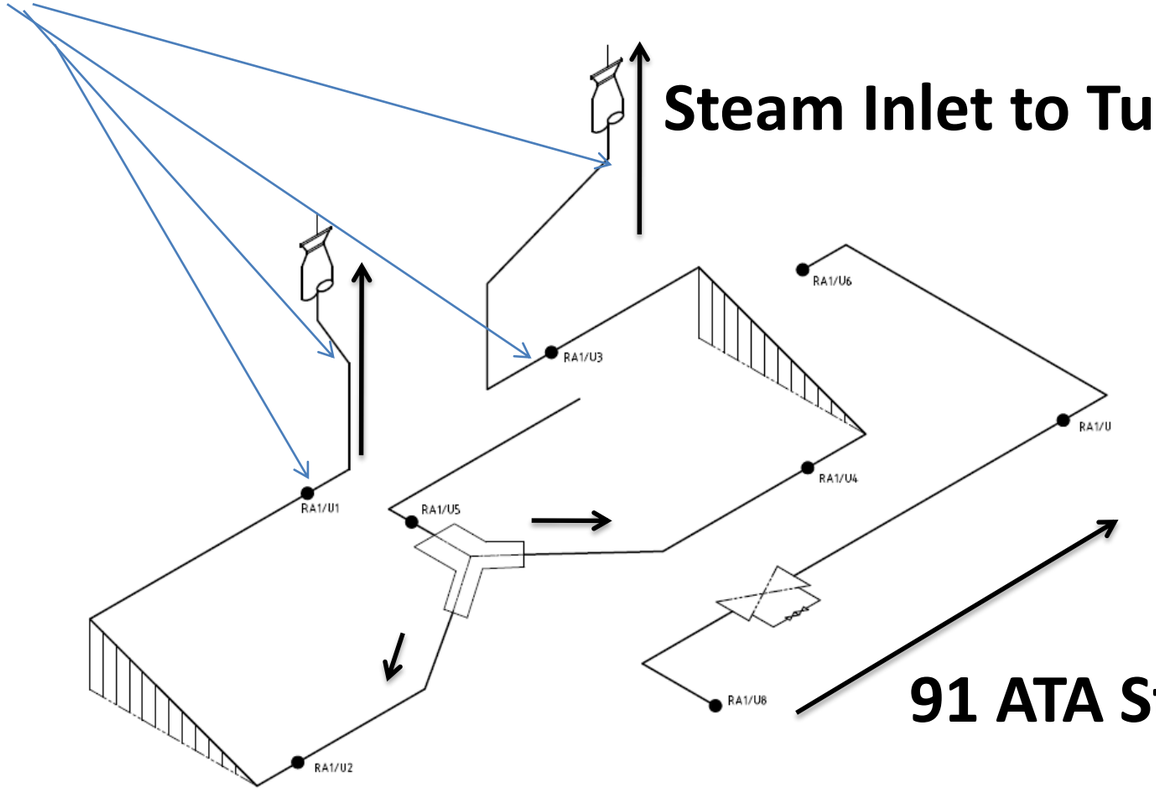
PARALLEL MISALIGNMENT



ANGULAR MISALIGNMENT

CORRECTION OF PIPING MISALIGNMENT BY CUTTING AND REWELDING THE HIGH PRESSURE/HIGH TEMPERATURE STEAM PIPING

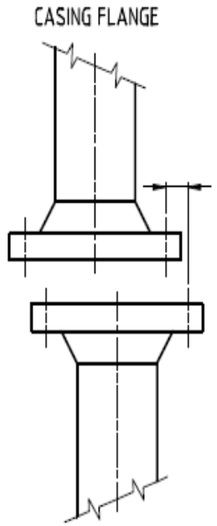
Welding Joints cut and
Pipe relocated



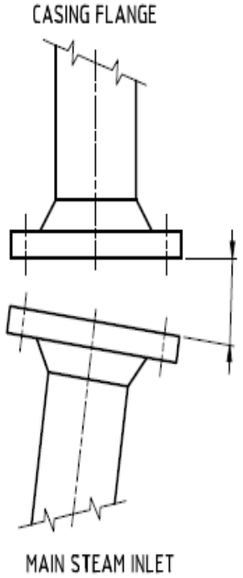
Steam Inlet to Turbine

91 ATA Steam from Boilers

MISALIGNMENT OF STEAM INLET FLANGES



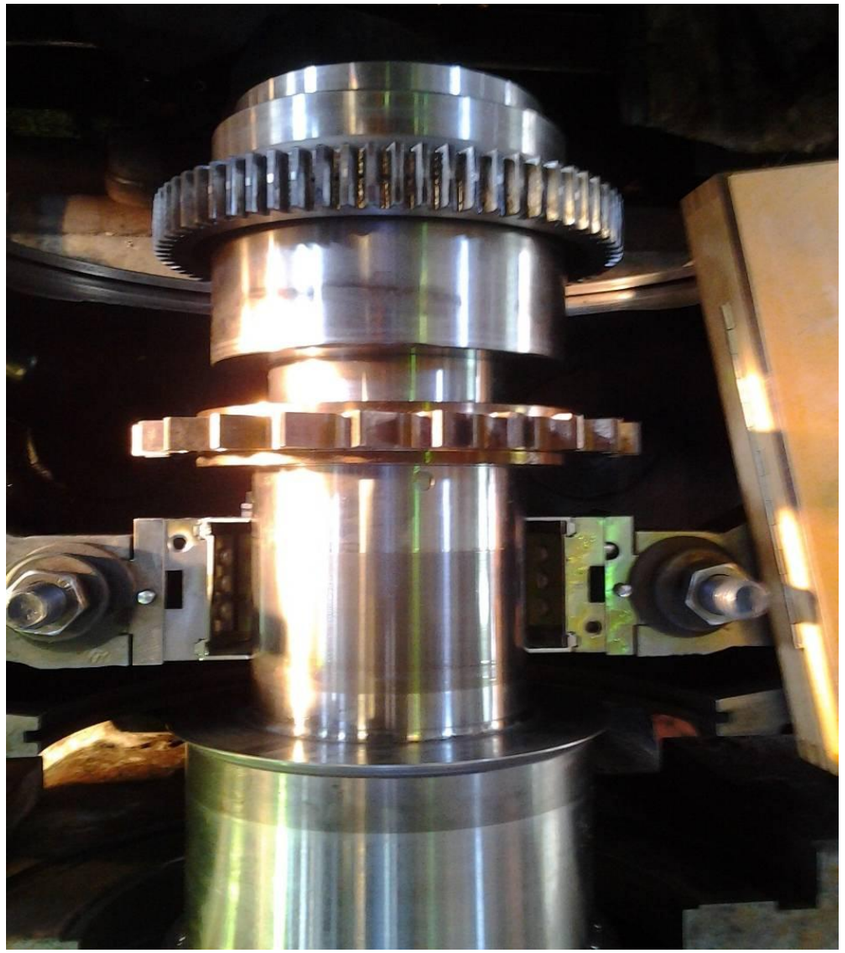
PARALLEL MISALIGNMENT

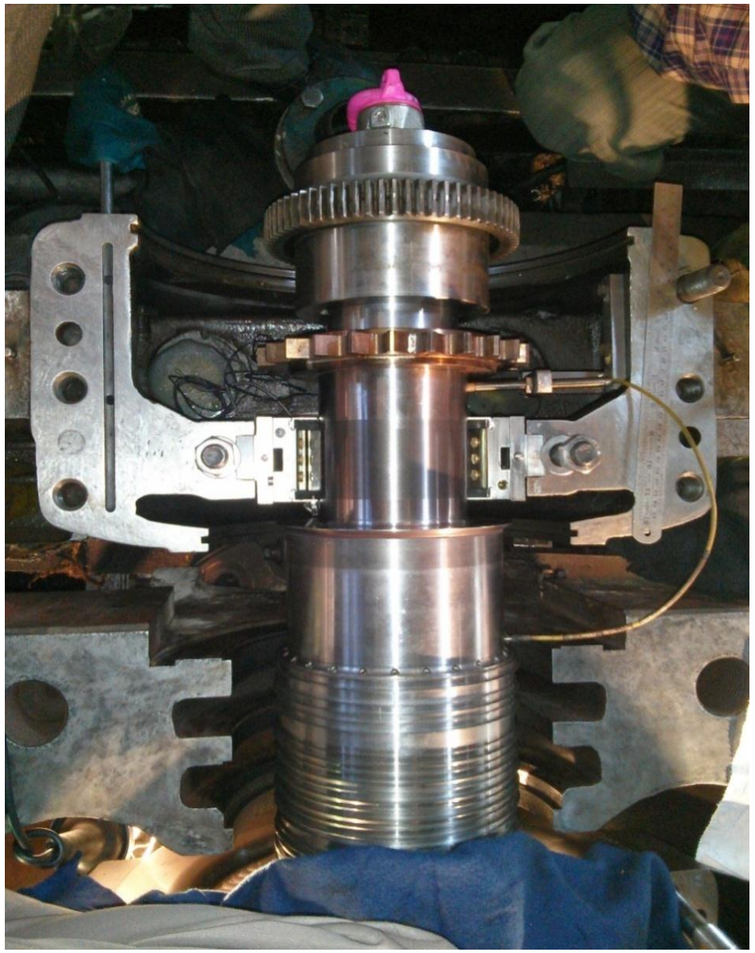


ANGULAR MISALIGNMENT

S. No.	Description	Main Steam Flange(Left)		Main Steam Flange (Right)	
		Before Correction	*After Correction*	*Before Correction*	*After Correction*
1	**Parallel Misalignment, in mm**	**50**	**2**	**45**	**2.5**
2	**Angular Misalignment, In mm**	**3.85**	**0.10**	**2.30**	**0.10**

Provision of Key Phasor





TEMPORARY STRAINERS WERE INSTALLED IN THE OIL PIPING FOR CLEANING OF LUBE OIL

DELAY ANALYSIS

- MACHINING OF BEARING PEDESTALS
- MACHINING OF L-RING SEATING AREAS IN TOP CASING
- REPLACEMENT OF CONTROL VALVE SEATS IN TOP CASING
- REMOVAL OF OLD STUDS AND FIXING OF NEW ONES
- FABRICATION OF HIGH PRECISION KEYS, LEVELLING PLATES,FIXTURES
- CORRECTION OF SIZES OF ESV SEAL RING-15 DEG. Vs 25 DEG.
- REMOVAL OF CENTER GUIDE KEYS & ECCENTRIC BUSHES IN BOTTOM CASING
- REPAIR OF SPRING SUPPORTS
- CORRECTION OF ALLIGNMENT OF PIPING
- CLEANING OF LUBE OIL-Bar Chart

Lessons Learnt:

Workshop facilities required during revamp to be recorded and suitable workshop to be located in advance. All machining jobs required to be done to be listed down and procedures to be framed.

Suitable Piping Team for carrying out alteration in Steam piping, consisting of skilled piping fitters and the IBR certified welders to be kept ready. Decision in this regard to be taken at the appropriate time inorder to save time loss due to decision making.

Lessons Learnt:

New set of Spring Supports may be kept available

Pre revamp meetings to be held between core team who has been assigned the revamp project from customer side as well as the OEM side.

Availability of Spares required during revamp.

Availability of all special tools and standard tools.

Cleaning of Lubricating Oil well in advance

THANKS